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Revision of the type material in the genus *Nathorstia* Heer (Filicales)

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ABSTRACT. ***Nathorstia angustifolia*** **Heer from the Lower Cretaceous of Greenland has been revised and the true status of the genus** ***Nathorstia*** **has been verified.** ***Nathorstia*** **Heer is redefined here as a morphogenus of fern foliage recalling the family Matoniaceae, but lacking diagnostic characters of this family: sori consisting of radially arranged sporangia having** ***Matoniaceaeporites*** **spores** ***in situ*****. All the type material has been restudied and documented, including unsuccessful attempts in sampling for spores in situ. The lectotype of** ***Nathorstia angustifolia*** **Heer is designed and its status is discussed.**

KEY-WORDS. ***Nathorstia*****, morphogenus, Greenland, Lower Cretaceous.**

INTRODUCTION

Nathorstia Heer, a genus of Cretaceous ferns, was a source of numerous discussions for a long time (Seward 1927, Hirmer & Hörhammer 1936, Krasilov 1964, Andrews et al. 1970, Van Konijnenburg-van Cittert 1993, Tidwell & Ash 1994). The main reason of these discussions was a question whether this genus should belong to the family Matoniaceae or Marattiaceae. Several species of *Nathorstia* have been described from various stratigraphic horizons of the Cretaceous of both Hemispheres. Early Cretaceous records of *Nathorstia* are known from Greenland (Heer 1880), Russia (Krasilov 1967) and Argentina (Halle 1913, Passalia 2007). Late Cretaceous (Cenomanian) records came from Greenland (Nathorst 1908) and the Czech Republic (Bayer 1899, Nathorst 1908, Pátová & J. Kvaček 2006). The diagnosis of the genus has been gradually shifted far from its original content (Krasilov 1964) and now it seems to be quite different from that proposed originally by Heer (1880). Because of this difficult and unclear situation, we have decided to revise the genus *Nathorstia* based on Heer's type material in order to fix the status of the genus. In the present paper we suggest an emendation of its diagnosis using information gained from the revision of the type material of *N. angustifolia* housed in the Naturhistoriska Riksmuseet, Stockholm.

MATERIAL AND METHODS

All the material we have studied originated from the western coast of Greenland, locality Pattorfik [= Pátorfik, 70.72˚N, 52.55˚W], where it was collected by the Nordenskiöld's expedition in 1870. The Pattorfik locality shows large profiles of the Kome Formation, which belongs to the Lower Cretaceous (Pedersen 1976), more precisely to the Aptian-middle Albian (K. R. Pedersen, personal communication in 2007). The material is preserved as leaf impressions in dark grey brown mudstone. Its precise lithology is not known, because the section was not re-visited. All the studied material is housed in the Naturhistoriska Riksmuseet, Stockholm, Sweden.

Material was examined by Zeiss Axioskop 2 plus stereomicroscope with Plan-neofluar objective and photographed by microscope camera AxioCam MRC and by digital camera Canon 300D with Sigma 1:2,8 macro lens. Images were adjusted in Adobe Photoshop. 7.0. Spores *in situ* were attempted to analyze using standard method published e.g. by Batten (1999).

SYSTEMATICS

Order Filicales

Family incertae sedis

Genus *Nathorstia* Heer 1880: 7

(non *Nathorstia* Seward 1894: 145)

TYPE: *Nathorstia angustifolia* Heer 1880: 7, pl. 1, figs 1-7. Accepted by Andrews (1970) and Van Konijnenburg-van Cittert (1993). For more arguments see below.

Nathorstia angustifolia Heer 1880

Text-figs 1a-d, 2a-f.

SYN: 1880 *Nathorstia angustifolia* Heer 1880: 7, pl. 1, figs 1-6.
?1880 *Nathorstia firm*a Heer 1880: 7, pl. 1, fig. 7.
?1868*Danaeites firmus* Heer 1868: 81, pl. 44, figs 20-22.

LECTOTYPE (designated here): S 112130a, figured on fig. 1a-c, (re-figured from Heer 1880, pl. 1, fig. 2).

TYPE LOCALITY: Pattorfik [= Pátorfik, 70.72˚N, 52.55˚W], Greenland.

TYPE HORIZON: Kome Formation, Lower Cretaceous.

OTHER MATERIAL: S108097, S112129, S1121306b, S112131, S112132a,b, S112133.

EMENDED DIAGNOSIS: Simple pinnate fronds, pinnules entire-margined, lanceolate with bluntly acute apex and narrowing base. Main rachis robust. Rounded depressions representing possibly remains of sori arranged in one row on each side of the midrib. Primary vein reaching apex of the pinnule, secondary venation unclear.

DESCRIPTION: The lectotype (fig. 1a) represents a fragment of entire-margined pinnule with well impressed rounded bodies representing possibly impressions of sori. The pinnule is 108 mm long and 5 mm broad. Shallow rounded depressions (sori) are arranged in

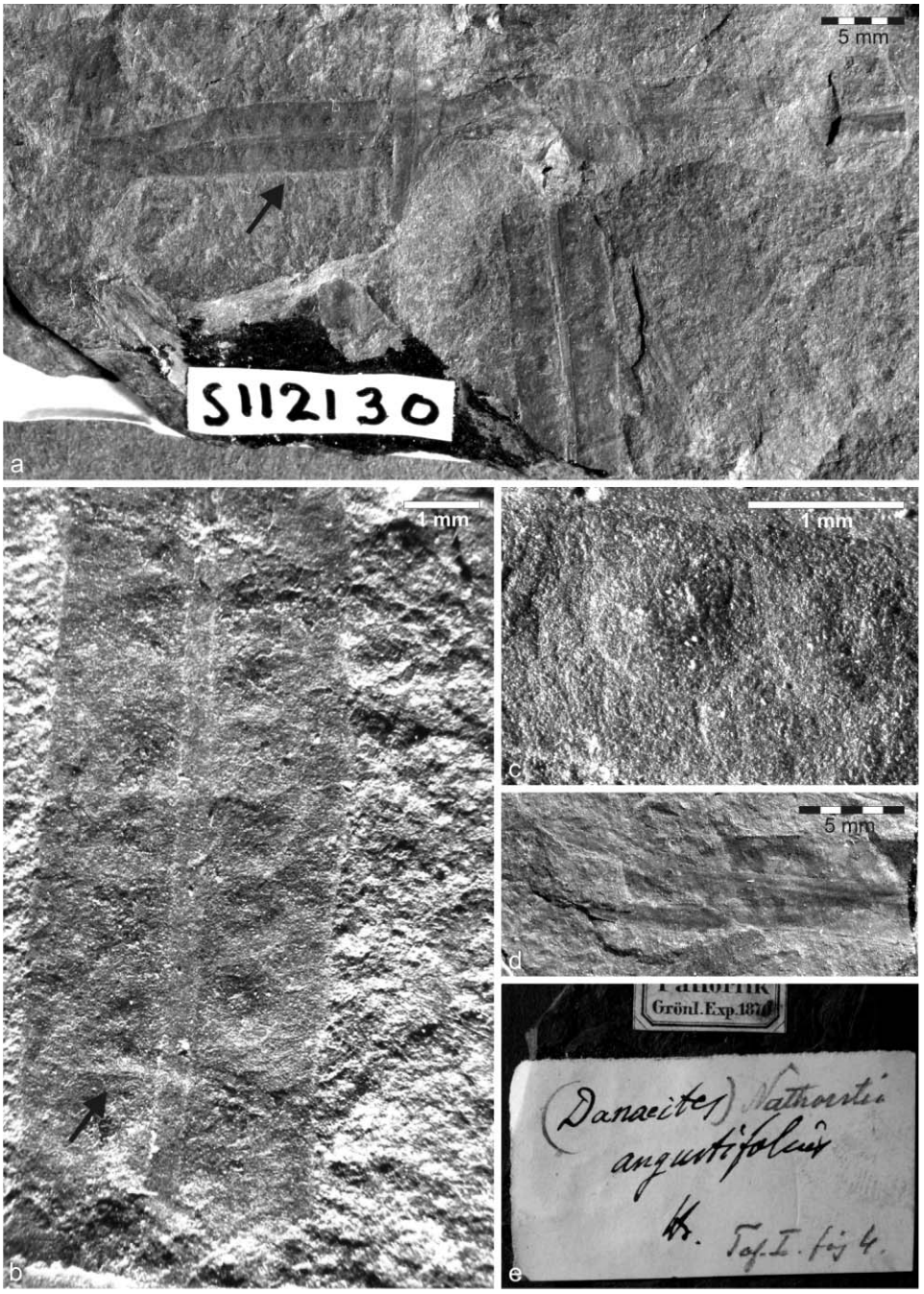

Fig. 1. ***Nathorstia angustifolia*** **Heer, Pattorfik. a – lectotype (arrowed S112130a) and fragment of pinnule (S112130b), Heer 1880, pl. 1, fig. 2, S112130a; b – detail of lectotype showing secondary vein, arrowed, Heer 1880, pl. 1, fig. 2, S112130a; c – detail of circular depression, Heer 1880, pl. 1, fig. 2, S112130a; d – basal part of pinnule, Heer 1880, pl. 1, fig. 4, S112132a; e – original handwritten label by Heer.**

two rows running parallel on each side of the primary vein (0.5 mm broad). Each depression (fig. 1b) is 0.8-1.1 mm in diameter. Some depressions are not completely rounded, showing slightly sinuate margin (fig. 1c). Venation of the pinnule is pinnate, but very poorly preserved. Secondary veins are leaving the midrib in right angles (fig. 2b). Further material described by Heer (1880) is represented by several fragments of pinnules having lamina 4-7.1 mm in breath and depressions 1-0.8 mm in diameter (fig. 1d, fig. 2 a-c, f). Two specimens from the type collection show fragments of compound leaves with pinnules narrowing to their base (fig 2 d,e). They are 15-34 mm in breath and 14-24 mm in length. Variability of the species is documented by additional fragments (No. S108097). All these specimens are accompanied with labels bearing Heer's autographs (fig. 1e).

DISCUSSION

The genus *Nathorstia* Heer (1880) is homonymous with *Nathorstia* Seward (*Nathorstia valdensis* Seward 1894, pl. 7, fig. 5, pl. 9, fig. 2) which represents a very different type of fern. The name *Nathorstia* Heer (1880) has priority over *Nathorstia* Seward (1894), which is illegitime.

In his paper on Greenland flora Heer (1880) mentioned two species: *Nathorstia angustifolia* Heer (1880) and *Nathorstia firma* (Heer) Heer (1880). The genus *Nathorstia* Heer is based on the type of *Nathorstia angustifolia* Heer, which is mentioned by Heer (1880) on the first place and mirrors his generic diagnosis. It is also generally accepted by other authors (Seward 1927, Andrews 1970, Van Konijnenburg - van Cittert 1993), although Farr et al. (1979) stated: "type non designatus" and Krasilov (1964) suggested *Reussia pectinata* as a type. The last suggestion would be only valid in case that Heer (1880) included *Reussia pectinata* Göppert in his protologue of *Nathorstia*. (*Reussia pectinata* Göppert is illegitimate name being based on illegitimate *Reussia* Presl 1838, non *Reussia* Endlicher 1836). However, Heer (1880) did not mention *R. pectinata* in his protologue and *R. pectinata* cannot be chosen for the type of the genus *Nathorstia*. Also the emendation of the genus *Nathorstia* by Krasilov (1964) is based on the specimens determined as *Nathorstia pectinata* (Göppert) Krasilov. These specimens are only slightly similar to *Nathorstia angustiloba* and the mutual comparison is not discussed by Krasilov (1964). He compares *N. pectinata* only to *Nathorstia latifolia* Nathorst from the Cenomanian of the Atane Formation in Greenland (Nathorst 1908).

Since times of Seward (1927) it is accepted that *N. angustifolia* includes *N. firma* from Kome in Greenland (Heer 1868, 1880). These two species differ only in the width of their pinnules and in the form of sori, which are oval in *N. firma*. After inspection of the specimens illustrated by Heer (1880) and housed in the Naturhistoriska Riksmuseet, Stockholm (Nr. S110074-01, S111082, S111144-02) we agree with Seward (1927) and Van Konijnenburg-van Cittert (1993) that a different shape of sori in *N. firma* was probably caused by deformation and that both species are very similar.

The type collection of *N. angustifolia* includes 5 specimens, which are poorly preserved impressions of sterile and fertile pinnules. Fertile pinnules show shallow rounded

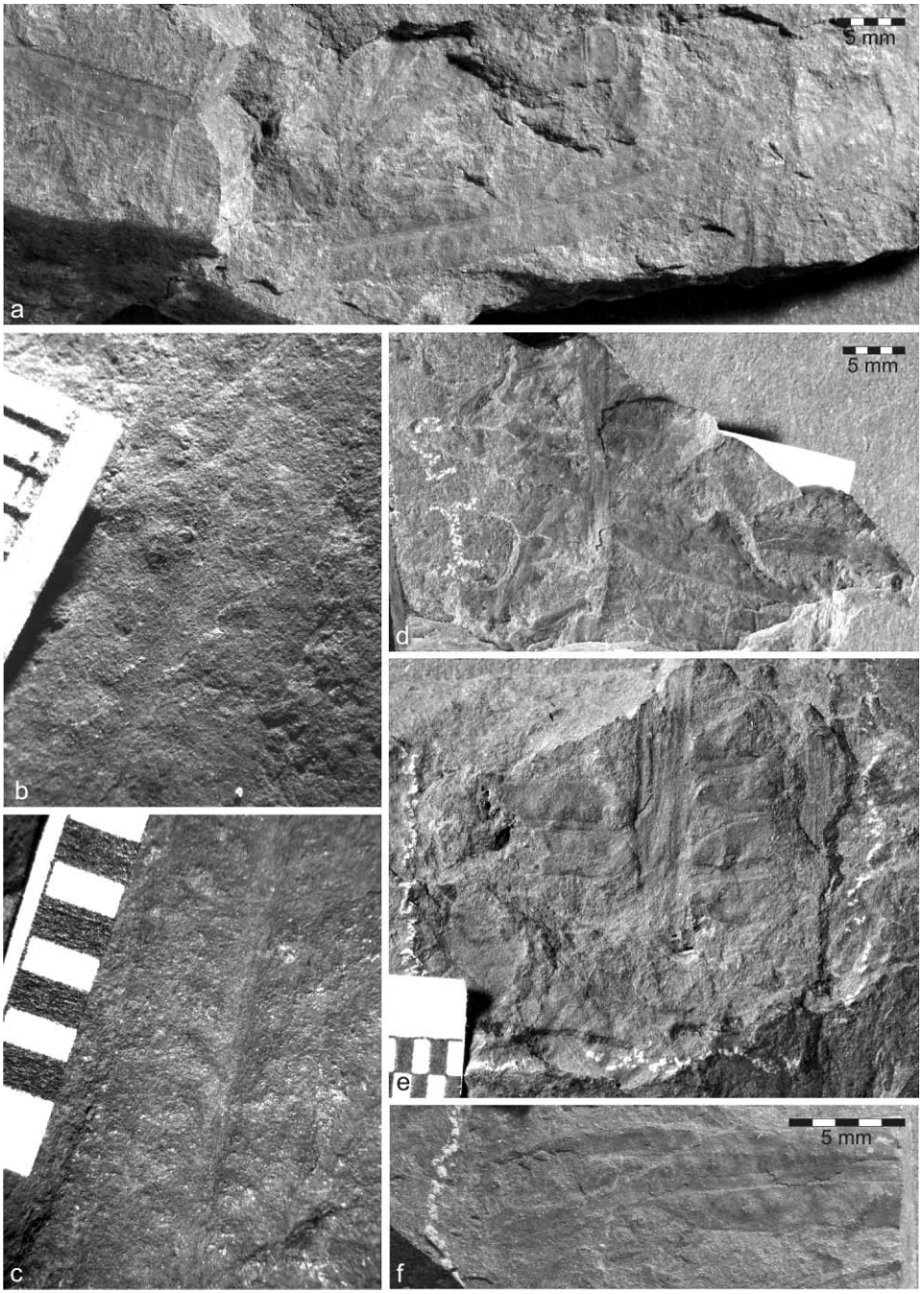

Fig. 2. ***Nathorstia angustifolia*** **Heer, Pattorfik. a – two fragments of pinnule, Heer 1880, pl. 1, fig. 1, S112129; b, c – details of pinnule, Heer 1880, pl. 1, fig. 1, S112129; d – fragment of pinnate frond, Heer 1880, pl. 1, fig. 3, S112131; e – fragment of pinnate frond, Heer 1880, pl. 1, fig. 5, S112133; f – basal part of pinnule, S112132b.**

depressions, probable remains of sori. It is not clear whether the sori are only impressed or whether they were detached before fossilization. Heer (1880) designating *Nathorstia* was not sure where the fern should be assigned systematically. He was discussing its similarity to "*Laccopteris dunkeri*" (Matoniaceae) and *Kaulfusia* (Marattiaceae). Later understanding of the genus *Nathorstia* was influenced by Nathorst (1808), who based his observations on *Nathorstia latifolia* interpreting its sori as fused in synangia. Nathorst (1908) compared *Nathorstia* with *Kaulfusia* and assumed that it belongs to the Marattiaceae. In the same way the genus was used by Halle (1913). Seward (1927) demonstrated that sporangia of *Nathorstia* are not fused and showed its great similarity to other fossil members of the Matoniaceae. However, Hirmer & Hörhammer (1936), revising fossil and recent genera of the Matoniaceae, excluded *Nathorstia* from the family and assigned it again to Marattiaceae. Krasilov (1964, 1967) in his studies on the Cretaceous flora from the Far East emended the genus *Nathorstia*. Unfortunately, for his emendation of the genus he used irrelevant material (see above). The material of *Nathorstia pectinata* (Göppert) Krasilov displays clearly isolated sporangia and spores of *Matoniaceaesporites* (Krasilov 1964, pl. 9) and other characters of the Matoniaceae. In the sense of Krasilov (1964) *Nathorstia* has been understood since its last revision (Van Konijnenburg-van Cittert 1993).

The present study of the type material of *Nathorstia angustifolia* reveals quite similar conclusions as suggested already by Seward (1927). However, it is absolutely impossible to show whether the depressions arranged in rows on pinnules represent sori or synangia (see figs 1 and 2). It is impossible to find clear diagnostic characters of the family Matoniaceae preserved in any specimen of the type collection. Poor impressions which could be interpreted as sporangia of *N. angustifolia* show that they were ovoid and not very many. The material definitely yielded no wedge-shaped sporangia, nor matoniaceous spores, which are preserved in many other species assigned to *Nathorstia* by later authors. Therefore, the genus *Nathorstia* is recommended here as a morphogenus accommodating impressions of fern fronds and isolated pinnae showing entire-margined lancoelate pinnules with clearly pronounced circular depressions (sori, synangia) running continuously on both sides of the midvein. Its systematic position is open. It probably belongs to the Matoniaceae, but could also represent poorly preserved fronds of ferns from other families, particularly from the Marattiaceae.

Those ferns recently assigned to *Nathorstia*, which show clear diagnostic characters of the family Matoniaceae (see Van Konijnenbirg-van Cittert 1993), should be transferred to another genus which will be published elsewhere (J. Kvaček & Dašková in prep.).

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REFERENCES

Andrews H.N., 1970: Index of generic names of fossil plants, 1820-1965. – Geological Survey Bulletin 1300: 1-354.

Andrews H.N., Arnold C.A., Boureau E., Doubinger J. & Leclercq S., 1970: Filicophyta. – In: Boureau E. (ed.): Traité de paléobotanique. Vol. 4(1): 1-519. Paris: Masson et Cie.

Batten D.J., 1999: Small palynomorphs. – In: Jones T.P. & Rowe N.P. (eds.): Fossil plants and spores: 15-19. London: The Geological Society.

Bayer E., 1899: Einige neue Pflanzen der Perucer Kreideschichten in Böhmen. – Sitzungsberichte der Königlich-Böhmischen Gesellschaft für Wissenschaften, Mathematisch-Naturwissenschaftiche Classe 30: 1-51.

Farr E.R., Leussink J.A. & Stafleu F.A., eds., 1979: Index nominum genericorum (Plantarum). – Regnum Vegetabile 100-102: 1-1896.

Halle T.G., 1913: Some Mesozoic plant-bearing deposits in Patagonia and Tierra del Fuego and their floras. – Kungliga Svenska Vetenskapsakademiens Handlingar 51(3): 1-58.

Heer O., 1868: Die fossile Flora der Polarländer – Flora fossilis arctica. Vol. 1. Zürich: F. Schulthess, 192 pp.

Heer O., 1880: Nachträge zur fossilen Flora Grönlands. – Kungliga Svenska Vetenskapsakademiens Handlingar 18(2): 1-17.

Hirmer M. & Hörhammer L., 1936: Morphologie, Systematik und geographische Verbreitung der fossilen und rezenten Matoniaceen. – Palaeontographica (B) 81: 1-66.

Krasilov V.A., 1964: O rode *Nathorstia* (paporotniki) [On the genus *Nathorstia* (ferns)]. – Paleontologičeskij Žurnal 1964(2): 115-120. [In Russian.]

Krasilov V.A., 1967: Rannemelovaâ flora Ûžnogo Primor'â i ee značenie dlâ stratigrafii [Early Cretaceous flora of southern Primorye and its significance for the stratigraphy]. – Moskva: Nauka, 248 pp. [In Russian.]

Nathorst A.G., 1908: Über *Nathorstia* Heer. – Kungliga Svenska Vetenskapsakademiens Handlingar 43(6): 14-19.

Passalia M.G., 2007: A mid-Cretaceous flora from the Kachaike Formation, Patagonia, Argentina. – Cretaceous Research 28: 830-840.

Pátová R. & Kvaček J., 2006: A report of ferns of the Bohemian Cenomanian and their spores in situ. – Acta Universitatis Carolinae, Geologica 47(1-4): 91-94.

Pedersen K.R., 1976: Fossil floras of Greenland. – In: Escher, A. & Stuart Watt, W. (eds): Geology of Greenland: 519-535. Copenhagen [= København]: Geological Survey of Greenland.

Seward A.C., 1894: Catalogue of the fossil plants in the Department of Geology, British Museum. The Wealden Flora – Pt. I. Thallophyta-Pteridophyta. London: British Museum (Natural History), 179 pp.

Seward A.C., 1927: On the Cretaceous plant-bearing rocks of Western Greenland. – Philosophical Transactions of the Royal Society of London (B) 215: 57-175.

Tidwell W.D. & Ash S.R., 1994: A review of selected Triassic to Early Cretaceous ferns. – Journal of Plant Research 107: 417-442.

Van Konijnenburg-van Cittert J.H.A., 1993: A review of the Matoniaceae based on in situ spores. – Review of Palaeobotany and Palynology 78: 235-267.